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NATIONAL DAM SAFETY PROGRAM. FLEMING DAM (INVENTORY NUMBER VA 0--ETC(U)
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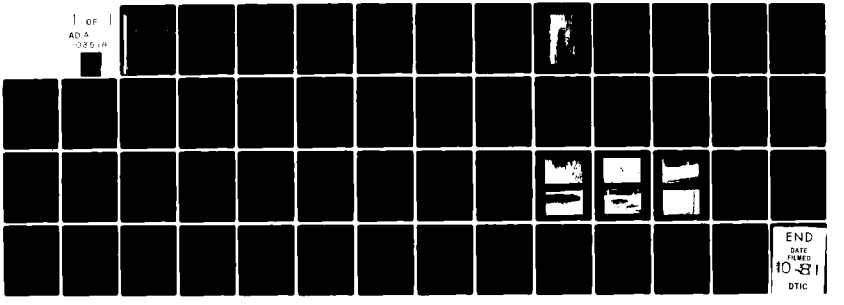

JAMES RIVER BASIN

Name of Dam: Fleming Dam
Location: Cumberland County, Commonwealth of Virginia
Inventory Number: VA 04904

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PREPARED FOR

NORFOLK DISTRICT CORPS OF ENGINEERS
803 FRONT STREET
NORFOLK, VIRGINIA 23510

PREPARED BY

MICHAEL BAKER, JR., INC.
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February 1981

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20. Abstract

Pursuant to Public Law 92-367, Phase I Inspection Reports are prepared under guidance contained in the recommended guidelines for safety inspection of dams, published by the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I Inspection is to indentify expeditiously those dams which may pose hazards to human life or property. The assessment of the general conditions of the dam is based upon available data and visual inspection. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

Based upon the field conditions at the time of the field inspection and all available engineering data, the Phase I report addresses the hydraulic, hydrologic, geologic, geotechnic, and structural aspects of the dam. The engineering techniques employed give a reasonably accurate assessment of the conditions of the dam. It should be realized that certain engineering aspects cannot be fully analyzed during a Phase I inspection. Assessment and remedial measures in the report include the requirements of additional indepth study when necessary.

Phase I reports include project information of the dam appurtenenances, all existing engineering data, operational procedures, hydraulic/hydrologic data of the watershed, dam stability, visual inspection report and an assessment including required remedial measures.

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of the Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (flood discharges that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the design flood should not be interpreted as necessarily posing a highly inadequate condition. The design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition, and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

CONTENTS

NAME OF DAM: FLEMING DAM

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam: Fleming Dam
State: Commonwealth of Virginia
County: Cumberland
USGS 7.5 Minute Quadrangle: Whiteville, Virginia
Stream: Maxey Mill Creek
Date of Inspection: 11 November 1980

BRIEF ASSESSMENT OF DAM

Fleming Dam is an earthfill embankment 29.4 feet high[1] and approximately 423 feet long. The principal spillway consists of a 36 inch diameter corrugated metal pipe (CMP) riser connected to a 24 inch diameter CMP outlet. The emergency spillway is a 50 foot wide vegetated earth channel adjacent to the right[2] abutment. The dam, located on Maxey Mill Creek approximately 3.7 miles northeast of Cumberland, Virginia, is used for recreation and as a stock pond. The dam is owned by Mr. John T. Clayton of Cumberland, Virginia. Fleming Dam is a "small" size - "significant" hazard structure as defined by the Recommended Guidelines for Safety Inspection of Dams. Visual inspection and office analyses indicate deficiencies requiring further investigation and remedial treatment. A stability check is not required.

Using the Corps of Engineers' screening criteria for initial review of spillway adequacy, the 100-year flood was selected as the spillway design flood (SDF). The spillway is capable of passing up to 45 percent of the SDF or 8 percent of the PMF without overtopping the dam. Overtopping flows during the SDF are not considered detrimental to the embankment.

The spillway is adjudged as inadequate. The spillway is not adjudged as seriously inadequate since dam failure from overtopping would not significantly increase the hazard to loss of life downstream from the dam over that which would exist just before overtopping failure.

A schedule of regular inspections and maintenance of the dam and appurtenant structures should be instituted. A check list should be compiled for use by the owner's representative as a guide for these inspections. Maintenance items

[1]Measured from the invert of the principal spillway outlet to the streambed at the downstream toe of the dam.
[2]Facing downstream.

should be corrected annually. A warning system and an emergency action plan should be developed and implemented as soon as possible.

The following repair items should be accomplished as part of the general maintenance of the dam:

1) Remove the large trees and their root systems from the downstream embankment. The slope should then be regraded with compacted fill.

2) Clear the brush and small trees (less than three inches in diameter) from the downstream embankment.

3) Backfill the animal burrows and establish a grass cover over the entire embankment.

4) Repair the erosion at the junction of the downstream embankment and the left abutment.

5) Clean the trash rack at the inlet to the principal spillway.

6) Repair the erosion rills in the emergency spillway approach channel.

7) Install a staff gage to monitor reservoir levels above normal pool.

It is also recommended that consideration be given to extending the embankment through the low area to the left of the existing left abutment. Flow through this low area could result in damage to the left abutment and the downstream embankment.

MICHAEL BAKER, JR., INC.

Michael Baker, III, P.E.
Chairman of the Board and
Chief Executive Officer

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APPROVED: Original signed by: Douglas L. Haller
Douglas L. Haller
Colonel, Corps of Engineers
District Engineer

Date: MAR 4 1981

COMMONWEALTH OF VIRGINIA
MICHAEL
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REGISTERED PROFESSIONAL ENGINEER

NAME OF DAM: FLEMING DAM

OVERALL VIEW OF DAM

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
NAME OF DAM: FLEMING DAM ID# VA 04904

SECTION 1 - PROJECT INFORMATION

1.1 General

1.1.1 Authority: Public Law 92-367, 8 August 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of safety inspections of dams throughout the United States. The Norfolk District has been assigned the responsibility of supervising the inspection of dams in the Commonwealth of Virginia.

1.1.2 Purpose of Inspection: The purpose is to conduct a Phase I inspection according to the Recommended Guidelines for Safety Inspection of Dams (Reference 12, Appendix IV). The main responsibility is to expeditiously identify those dams which may be a potential hazard to human life or property.

1.2 Description of Project

1.2.1 Description of Dam and Appurtenances: The Fleming Dam is an earthfill embankment 29.4 feet high[1] and approximately 423 feet long. The slope of the upstream embankment varies from about 3.3H:1V to 3.9H:1V (Horizontal to Vertical). The slope on the majority of the downstream embankment is approximately 1.8H:1V, except for the area directly above the principal spillway outlet, where the slope is approximately 2.6H:1V. The crest width varies from 15.4 feet to 24.3 feet, with the average width being about 15.5 feet. The crest elevations vary from a maximum of 326.8 feet Temporary Bench Mark (T.B.M.)[2] near the

[1]Measured from the embankment crest to the streambed at the downstream toe of the dam.
[2]All elevations are referenced to a Temporary Bench Mark set on the top of the riser during the field inspection. The assumed elevation, and approximate Mean Sea Level elevation, of this point is 320.0 feet T.B.M.

center of the embankment to a minimum of 324.7 feet T.B.M. at the right[3] abutment. There is no riprap on the embankment.

A stone wall, 6 feet high and 75 feet long, runs along a portion of the toe of the downstream embankment. It is not known if a cutoff trench or grout curtain was constructed beneath the dam or if an internal drainage system was installed.

The principal spillway intake structure is a vertical 36 inch corrugated metal pipe (CMP) acting as a riser, located near the center of the embankment approximately 10 feet from the upstream embankment. The crest of the riser is at elevation 320.0 feet T.B.M. The trash rack for the principal spillway is a cage of steel reinforcing bars welded together to the upper end of the riser. The principal spillway conduit is a 24 inch bituminous coated CMP approximately 125 feet long. From the outlet of the conduit pipe, located at the toe of the downstream embankment, the primary spillway discharge channel extends approximately 50 feet downstream, where it merges with the emergency spillway discharge channel to form the downstream channel.

An emergency spillway is cut into the right abutment of the embankment. The control section is not well defined but is approximately trapezoidal shaped with a bottom width of about 50 feet and a depth below the right abutment of about 2.6 feet. The left side slope rises to the right abutment at about a 9H:1V slope and the right side slope rises to natural ground at about a 15H:1V slope. The discharge channel curves to the left downstream of the embankment and runs approximately 400 feet to its intersection with the principal spillway discharge channel.

An emergency gate is located approximately 30 feet upstream of the principal spillway riser. A stem extends from the gate to above the normal pool level. The size of the emergency gate is not known.

[3]Facing downstream.

There is a low area approximately 125 feet wide in the natural ground to the left of the left abutment. This area has a minimum elevation of 324.0 feet T.B.M., or 1.6 feet below the elevation of the left abutment. During high flow periods, water could flow around the dam through this depression, down VA Route 646, which runs beside the dam, and into the downstream channel beyond the downstream toe of the embankment.

1.2.2 Location: Fleming Dam is located on Maxey Mill Creek just upstream of Virginia Route 646 and approximately 3.5 miles upstream of Virginia Route 654. The dam is approximately 0.6 miles southeast of the intersection of Virginia Route 646 and U.S. Route 60 in Cumberland County, Virginia. A Location Plan is included in Appendix I of this report.

1.2.3 Size Classification: The height of the dam is 29.4 feet; the reservoir storage capacity at the minimum crest elevation of the dam (elevation 324.7 feet T.B.M.) is approximately 156 acre-feet. Therefore, the dam is in the "small" size category as defined by the Recommended Guidelines for Safety Inspection of Dams.

1.2.4 Hazard Classification: There is one house and garage approximately 300 feet downstream of the dam, approximately the same elevation as normal pool. A gravel road (Virginia Route 646) crosses Maxey Mill Creek approximately 300 feet downstream of the dam. Four 24 inch diameter CMPs underlie the road. Two of these are mostly plugged with silt and abandoned. The remaining two pipes are mostly submerged and would not handle much flow. Although loss of life is not highly probable, economic loss in the form of damage to one residence and garage and to Virginia Route 646 is likely in the event of dam failure. Fleming Dam is therefore considered to be in the "significant" hazard category as defined by the Recommended Guidelines for Safety Inspection of Dams. The hazard classification used to categorize dams is a function of location only and is not related to the stability or probability of failure of the dam.

1.2.5 Ownership: Fleming Dam is owned by Mr. John T. Clayton, Jr., of Cumberland, Virginia.

1.2.6 Purpose of Dam: The dam is used to impound water for recreational purposes and as a water supply for livestock.

1.2.7 Design and Construction History: It is not known when the dam was originally constructed. The principal spillway was replaced and the central portion of the embankment reconstructed by the Easter Construction Company in 1969 (Reference 11, Appendix IV).

1.2.8 Normal Operating Procedures: The reservoir is normally maintained at the crest of the principal spillway, elevation 320.0 feet T.B.M. No formal operating procedures are followed for this structure. Information pertaining to the manually operated emergency gate is presented in paragraphs 4.1 and 4.3.

1.3 Pertinent Data

1.3.1 Drainage Area: The drainage area tributary to the dam is 2.5 square miles.

1.3.2 Discharge at Dam Site: The maximum discharge from the reservoir is unknown. Debris along the upstream embankment was observed during the field investigation, indicating that the reservoir level has in the past reached an elevation of at least 322.2 feet T.B.M. The discharge from the reservoir with the pool at this elevation has been estimated to be approximately 50 cubic feet per second (c.f.s.).

Emergency Spillway:
Pool Elevation at Minimum Top of Dam . . . . . .1040 c.f.s.

1.3.3 Dam and Reservoir Data: Pertinent data on the dam and reservoir are shown in the following table:

NAME OF DAM: FLEMING DAM

TABLE 1.1 DAM AND RESERVOIR DATA

Item	Elevation (feet T.B.M.)	Reservoir Capacity			Length (feet)
		Area (acres)	Acre-feet	Watershed (inches)	
Minimum top of dam	324.7	25.0	156	1.2	2500
Low area to left of left abutment	324.0	23.6	139	1.1	2300
Emergency spillway crest	321.9	18.0	96	0.7	1800
Principal spillcrest (Normal Pool)	320.0	12.6	67	0.5	1400
Streambed at downstream toe of dam	295.3	-	-	-	-

NAME OF DAM: FLEMING DAM

SECTION 2 - ENGINEERING DATA

2.1 Design: No design drawings, construction calculations, stability analyses or any other design data were available for review in preparing this report.

2.2 Construction: No construction records, as-built plans, or inspection logs were available for review in preparing this report.

2.3 Evaluation: No design or construction records were available to adequately assess the condition of the dam. All evaluations and assessments in this report were based on field observations, discussions with the owner, and office analyses.

SECTION 3 - VISUAL INSPECTION

3.1 Findings

3.1.1 General: The field inspection was conducted on 11 November 1980. At the time of the inspection the pool elevation was 320.6 feet T.B.M. and the tailwater elevation was 297.5 feet T.B.M. The weather was clear with temperatures in the mid 40's (degrees Fahrenheit). The ground surface at the embankment and the abutments was generally dry. The dam and appurtenant structures were found to be in generally fair overall condition at the time of the inspection. A Field Sketch of conditions found during the inspection is presented as Plate 1 in Appendix I. The complete visual inspection check list is given in Appendix III. No records of previous inspections were available.

3.1.2 Embankment: The embankment was found to be in generally fair condition. No surface cracks or unusual movement or cracking at or beyond the toe were observed. The upstream embankment is gently sloping and well vegetated with grass with no signs of erosion or instability. Heavy vegetation at the waterline of the upstream embankment, consisting of high grass and cattails, protects the embankment against erosion from wave action. The downstream embankment is densely overgrown with brush and trees, many of which are large and very old. Numerous animal burrows were also observed on the downstream embankment. Generally the embankment appears very stable, though it is mostly quite steep and irregular. A flatter section of the embankment that is not overgrown is situated above the principal spillway outlet structure. A six foot high stone wall, approximately 75 feet long, is located along the toe of the downstream embankment approximately 125 feet left of the principal spillway outlet structure and is in good condition.

The horizontal alignment of the dam curves gently along its entire length, with the concave side toward the reservoir. The vertical alignment of the embankment appears

satisfactory. To the left of the left abutment, the natural ground and road surface form a low area approximately 125 feet wide with a maximum depth of 1.6 feet below the left abutment elevation.

A few wet areas were observed beyond the downstream toe of the dam. However, these wet areas are apparently due to poor drainage conditions of areas below the dam, not to seepage through the embankment.

No drains or signs of an internal drainage system were found during the field investigation.

The junctions of the embankments with the abutments are generally in good condition. Slight erosion from road drainage has occurred at the junction of the downstream embankment with the left abutment.

3.1.3 Appurtenant Structures: The intake structure of the principal spillway consists of a vertical 36 inch diameter CMP acting as a riser. This inlet is enclosed in a two foot high cage made of reinforcing rods welded together to form a trash rack. A few inches of leaves and weedy material is plugging the bottom of the trash rack. The outlet conduit is a 24 inch diameter bituminous coated CMP, which is in good condition. The outlet structure consists of the end of the 24 inch conduit protruding directly from the embankment with no visible supporting structure. The immediate outlet area is well riprapped with slate. The outlet channel is generally wide and unobstructed and extends from the outlet structure approximately 50 feet downstream, where it merges with the emergency spillway discharge channel to form the downstream channel. During the field inspection, the flow through the principal spillway was approximately 2 c.f.s.

The emergency spillway is adjacent to the right abutment of the embankment. The approach channel is wide, well vegetated with grass and unobstructed. A few minor erosion rills are present. The control section is

quartzite bedrock covered by a thin mantle of soil, less than one foot deep, with grass cover. Both side slopes are composed of earth with a good grass cover. The discharge channel immediately downstream of the control section is wide and unobstructed. The quartzite bedrock is exposed on the channel bottom just below the control section. The bedrock appears to strike N50°W and dip 10°NE and is highly jointed. A low wall of quartzite riprap has been placed on the left side of the channel just downstream of the control section to protect the right abutment. Approximately 100 feet downstream of the control section, a deep gully has been eroded in the quartzite on the right side of the channel. Below this point, the channel is wide, unobstructed and well vegetated with grass to its intersection with the principal spillway discharge channel, approximately 300 feet downstream.

The emergency gate is located approximately 30 feet upstream of the riser. The size of the emergency gate is unknown and the control wheel is missing from the gate stem.

3.1.4 Reservoir Area: The slopes around the reservoir are very gentle. Half of the slopes are heavily wooded and the remainder is pastureland, used for grazing horses. Upstream of the reservoir, the drainage area is approximately 90 percent woodlands and 10 percent pastureland.

The extent of sedimentation was not directly observed, but is not expected to be significant. Soundings were taken during the inspection; the greatest depth measured was 14 feet.

3.1.5 Downstream Channel: A gravel road (Virginia Route 646) crosses Maxey Mill Creek approximately 300 feet downstream of the dam. Four 24 inch diameter CMPs underlie the road. Two of these are mostly plugged with silt and abandoned. The remaining two pipes are mostly submerged and would not handle much flow. Below the road, the stream flows through a fairly wide wooded valley. The

stream has a slope of approximately 0.6 percent in the area downstream of the dam. There is one house and garage approximately 300 feet downstream of the dam, built at approximately the same elevation as normal pool.

3.1.6 Instrumentation: There is no instrumentation at the dam site.

3.2 Evaluation: In general, the dam and appurtenant structures are in fair condition. The large trees and their root systems should be removed from the downstream embankment. The slope should then be regraded with compacted fill. The brush and trees with a trunk diameter less than three inches should be cut at ground level and removed. The animal burrows should be backfilled. The slope should then be reseeded with grass and mulched. The embankment should be extended approximately 125 feet beyond the existing left abutment to prevent flow through the low area, which could result in damage to the abutment and downstream embankment. This area should be filled to the elevation of the left abutment, compacted, seeded and mulched. The area where erosion from road drainage has occurred at the junction of the downstream embankment with the left abutment should be filled, regraded, compacted and reseeded. The wet areas below the toe of the dam are attributed to poor drainage of areas below the dam, not to seepage through the embankment. As such, the wet areas do not have a detrimental effect on the dam and no corrective measures are required. The trash rack enclosing the intake structure of the principal spillway should be periodically cleaned to prevent possible obstruction of the principal spillway. The control wheel should be either permanently installed or stored in an easily accessible location. The minor erosion rills in the emergency spillway approach channel should be filled, compacted, seeded and mulched. The gully in the emergency spillway discharge channel is on the side of the channel away from the embankment and poses no threat to the stability of the dam. Therefore, no remedial measures are required. A staff gage should be installed to monitor reservoir levels above normal pool.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 Procedures: Operation of the dam is an automatic function controlled by the principal and emergency spillways. The normal reservoir elevation of 320.0 feet T.B.M. is maintained by the crest of the principal spillway. When reservoir elevations exceed 321.9 feet T.B.M., additional flow is discharged through the emergency spillway.

4.2 Maintenance of Dam: Maintenance of the dam is the responsibility of the owner. An inspection or maintenance schedule has not been instituted.

4.3 Maintenance of Operating Facilities: Maintenance of the operating facilities is the responsibility of the owner. The only operating facility at the dam is the emergency gate. No record of either the use or maintenance of this operating facility is available and no schedule for the maintenance of this operating facility has been instituted.

4.4 Warning System: At the present time, there is no warning system or emergency action plan in operation.

4.5 Evaluation: Maintenance of the dam in the past has been inadequate. Regular inspections should be made of the dam and appurtenant structures. A thorough check list should be compiled for use by the owner's representative as a guide for the inspections. Maintenance items should be corrected annually. A warning system and emergency action plan should be developed and implemented as soon as possible.

SECTION 5 - HYDRAULIC/HYDROLOGIC DATA

5.1 Design: No hydraulic or hydrologic design data were available for use in preparing this report.

5.2 Hydrologic Information: No rainfall, stream gage or reservoir stage records are maintained for this dam.

5.3 Flood Experience: There are no exact high water marks from past floods available at the dam site. During the field inspection, debris was observed along the upstream embankment, suggesting that the reservoir level at some time had risen to an elevation of approximately 322.2 feet T.B.M.

5.4 Flood Potential: The Probable Maximum Flood (PMF), the 1/2 Probable Maximum Flood (1/2 PMF) and the 100-year flood were developed and routed through the reservoir by use of the HEC-1 DB computer program (Reference 9, Appendix IV) and appropriate unit hydrograph, precipitation and storage-outflow data. Clark's T_c and R coefficients for the local drainage areas were estimated from basin characteristics. The rainfall applied to the unit hydrograph was taken from publications by the U.S. Weather Bureau and the National Oceanic and Atmospheric Administration (References 16 and 17, Appendix IV). Rainfall losses for the PMF were estimated at an initial loss of 1.0 inches and a constant loss rate of 0.05 inches per hour thereafter. Rainfall losses for the 100-year flood were estimated at an initial loss of 1.50 inches and a constant loss rate of 0.15 inches per hour thereafter.

5.5 Reservoir Regulation: Pertinent dam and reservoir data are shown in Table 1.1, paragraph 1.3.3.

Regulation of flow from the reservoir is automatic. Normal flows are maintained by the crest of the principal spillway at elevation 320.0 feet T.B.M.

Outlet discharge capacities were computed by hand; reservoir area was planimetered from the Whiteville, Virginia 7.5 minute USGS quadrangle; and storage capacity was computed by the HEC-1 DB program. Outlet discharge capacity and storage capacity curves were computed to elevations above the crest of the dam. The low area to the left of the left abutment was included in the outlet discharge capacity curve. All flood

routings were begun with the reservoir level at normal pool. Flows through the principal spillway were included in the routings.

5.6 Overtopping Potential: The probable rise of the reservoir and other pertinent information on reservoir performance are shown in the following table:

TABLE 5.1 RESERVOIR PERFORMANCE

Item	Normal[1]	Hydrographs 100-Year flood	1/2 PMF	PMF[2]
Peak flow, c.f.s.				
Inflow	8.0	2,394	6,614	13,227
Outflow	8.0	2,320	6,583	13,176
Peak elev., ft. T.B.M.	320.6	325.7	327.2	328.5
Emergency spillway[3] (elev. 321.9 ft. T.B.M.)				
Depth of flow, ft.	-	3.8	5.3	6.6
Average velocity, f.p.s.	-	9.0	10.7	11.9
Total duration of overtopping, hrs.	-	9.2	27.2	50.0
Non-overflow section[3] (elev. 324.7 ft. T.B.M.)				
Depth of flow, ft.	-	1.0	2.5	3.8
Average velocity, f.p.s.	-	4.6	7.3	9.0
Total duration of overtopping, hrs.	-	2.8	6.0	12.2
Tailwater elev., ft. T.B.M.	297.5	-	-	-

[1]Conditions at time of inspection.
[2]The PMF is an estimate of flood discharges that may be expected from the most severe combination of critical meterologic and hydrologic conditions that are reasonably possible in a region.
[3]Velocity estimates were based on critical depth at control section.

5.7 Reservoir Emptying Potential: No design plans or construction drawings showing the exact dimensions of the emergency drain or gate control were available. For determining the reservoir dewatering data, it was assumed that the emergency drain was a 24 inch CMP, 30 feet long and constructed at a 2 percent slope, which is the same type, size and slope of the outlet conduit

of the principal spillway. The emergency drain was assumed to extend from the emergency gate control tower to the base of the riser, where flows could be discharged through the embankment by the principal spillway outlet conduit.

Neglecting inflow, the reservoir can be drawn down from the normal pool elevation of 320.0 feet T.B.M. to elevation 304.0 feet T.B.M. in approximately 1.1 days. This is equivalent to an approximate drawdown rate of 14.5 feet per day, based on the hydraulic height measured from normal pool divided by the time to dewater the reservoir.

5.8 Evaluation: Fleming Dam is a "small" size - "significant" hazard dam requiring evaluation for a spillway design flood (SDF) in the range between the 100-year flood and the 1/2 PMF. Due to the risk involved, the 100-year flood has been selected as the SDF. The 100-year flood was routed through the reservoir and found to reach a maximum water surface elevation 1.0 feet above the minimum top of dam elevation. The spillway is capable of passing approximately 45 percent of the SDF or 8 percent of the PMF without overtopping the crest of dam.

Conclusions pertain to present-day conditions and the effect of future development on the hydrology has not been considered.

SECTION 6 - DAM STABILITY

6.1 Foundation and Abutments: No previous information describing local subsurface conditions was available for the visual inspection or subsequent analyses. The dam is located in the Piedmont physiographic province of Virginia. The topography of the Piedmont generally consists of rolling hills and gentle slopes with relief less than 150 feet. Granite of uncertain age is shown on the Geologic Map of Virginia as underlying the dam. However, quartzite was observed on the right abutment during the visual inspection. Extensive bands of metamorphosed volcanic and sedimentary rocks are located slightly to the north and south of Fleming Dam, according to the available geologic map. The quartzite may be a continuation of this deposit.

It is not known how the dam was keyed into the foundation and abutments. Relatively thick residual soils may be expected beneath the dam. The Piedmont is reported to contain widespread, thick (50-150 feet) residual soils. Local soils examined during the visual inspection appeared to be very sandy.

6.2 Embankment

6.2.1 Materials: No information describing the nature of embankment materials or any zoning of the embankment was available for this inspection. During the field inspection, the outer embankment materials were determined to consist of brown silty fine sand to sandy silt (ML group soil - Unified Classification System).

6.2.2 Stability: Design plans and the results of a previous stability analysis, if any, were not available for use during this evaluation. The embankment is assumed to be a generally homogeneous type. The dam is 29.4 feet high with a crest width of 15 feet. The upstream embankment slope was measured as between 3.3-3.9H:1V. Most of the downstream embankment slope is approximately 1.8H:1V. The downstream embankment slope is much flatter, 2.6H:1V, in the area around the principal spillway outlet. Approximately 75 feet of the left section of the downstream embankment is supported by an old 6 foot high, stone

retaining wall. An emergency gate is apparently available to drain the impoundment, if necessary.

According to guidelines outlined in Design of Small Dams by the U. S. Department of the Interior, Bureau of Reclamation, the upstream slope of a small homogenous dam constructed of CL or ML type soils, with a stable foundation, should be 3.5H:1V if the dam is subject to rapid drawdown. The downstream slope recommended is 2.5H:1V. A crest width of 14.6 feet is recommended, considering the height of the dam.

No signs of instability in the dam, such as slumping, tension cracks, or unusual alignment along the crest were detected during the visual inspection. However, the downstream embankment was densely overgrown, which hampered the inspection of that portion of the dam. Numerous large trees were present. Much of the downstream embankment was very steep and irregular in nature, but it was generally not eroded due to the dense overgrowth. The portion of the downstream embankment supported by the stone retaining wall appeared to be stable. The retaining wall itself was in good condition. Numerous animal burrows were observed in the downstream embankment. Although an internal drainage system was apparently lacking, the lower section of the downstream embankment was dry. A few wet areas were noted beyond the toe of the dam, but these areas were considered to be related to poor surface drainage rather than seepage.

6.2.3 Seismic Stability: The dam is located in Seismic Zone 2 which presents no hazard from earthquakes according to the Recommended Guidelines for Safety Inspection of Dams by the Department of the Army, Office of the Chief of Engineers. This determination is contingent on the requirements that static stability conditions are satisfactory and conventional safety margins exist.

6.3 Evaluation: The upstream embankment slope and crest width are satisfactory according to guidelines by the Bureau of Reclamation. The downstream embankment is

considerably steeper than recommended; however, the existing slope shows no signs of instability, even though it is quite irregular and penetrated by numerous animal burrows. A stability check is not required.

As described in Section 5.8 of this report, the dam would be overtopped by the SDF. The SDF would overtop the dam by a maximum depth of 1.0 feet with an average critical velocity of 4.6 feet per second (f.p.s.). Total duration of overtopping would be 2.8 hours.

Despite the inability of the spillway to pass the design flood, the depth, duration, and rate of overtopping are not considered detrimental to the embankment. Overtopping flows are shallow, last less than 3 hours, and the velocity is less than 6 f.p.s., the effective eroding velocity for a vegetated earth embankment.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment: There were no engineering data available for use in preparing this report. Deficiencies discovered during the field inspection and office analyses will require remedial treatment. The dam and appurtenant structures are generally in fair condition. Maintenance of the dam is considered inadequate. A stability check is not required.

Using the Corps of Engineers' screening criteria for initial review of spillway adequacy, the 100-year flood was selected as the SDF for the "small" size - "significant" hazard classification of Fleming Dam. The spillway is capable of passing up to 45 percent of the SDF or 8 percent of the PMF without overtopping the dam. Overtopping flows during the SDF are not considered detrimental to the embankment.

The spillway is adjudged as inadequate. The spillway is not adjudged as seriously inadequate since dam failure from overtopping would not significantly increase the hazard to loss of life downstream from the dam over that which would exist just before overtopping failure.

The downstream embankment is overgrown with heavy brush and trees and many animal burrows are present. Minor erosion has occurred at the junction of the downstream embankment with the left abutment and also in the approach channel of the emergency spillway. To the left of the left abutment the natural ground and road surface form a low area approximately 125 feet long with a maximum depth of 1.6 feet below the left abutment elevation. The bottom of the trash rack enclosing the intake structure of the principal spillway is obstructed with several inches of leaves and weedy material. The control wheel for the emergency gate is missing. There is no staff gage or recording device to monitor reservoir levels.

Several wet areas were noticed below the dam, but these are attributed to poor drainage conditions of areas below the dam and not to seepage through the embankment. A deep gully was eroded in the bedrock on the right side of the emergency spillway discharge channel (away from the embankment) about 100 feet downstream of the control section. Neither of these items poses a threat to the stability of the dam.

Neither an inspection nor maintenance schedule for the dam or operating facilities has been instituted. There is no warning system or emergency action plan currently in operation.

7.2 Recommended Remedial Measures: A schedule of regular inspections and maintenance of the dam and appurtenant structures should be instituted. A check list should be compiled for use by the owner's representative as a guide for the inspections. Maintenance items should be corrected annually. A warning system and emergency action plan should be developed and put into operation.

The following repair items should be accomplished as part of the general maintenance of the dam:

1) Remove the large trees and their root systems from the downstream embankment. The slope should then be regraded with compacted fill.

2) Clear the brush and small trees (less than three inches in diameter) from the downstream embankment.

3) Backfill the animal burrows and establish a grass cover over the entire embankment.

4) Repair the erosion at the junction of the downstream embankment and the left abutment.

5) Clean the trash rack at the inlet to the principal spillway.

6) Repair the erosion rills in the emergency spillway approach channel.

7) Install a staff gage to monitor reservoir levels above normal pool.

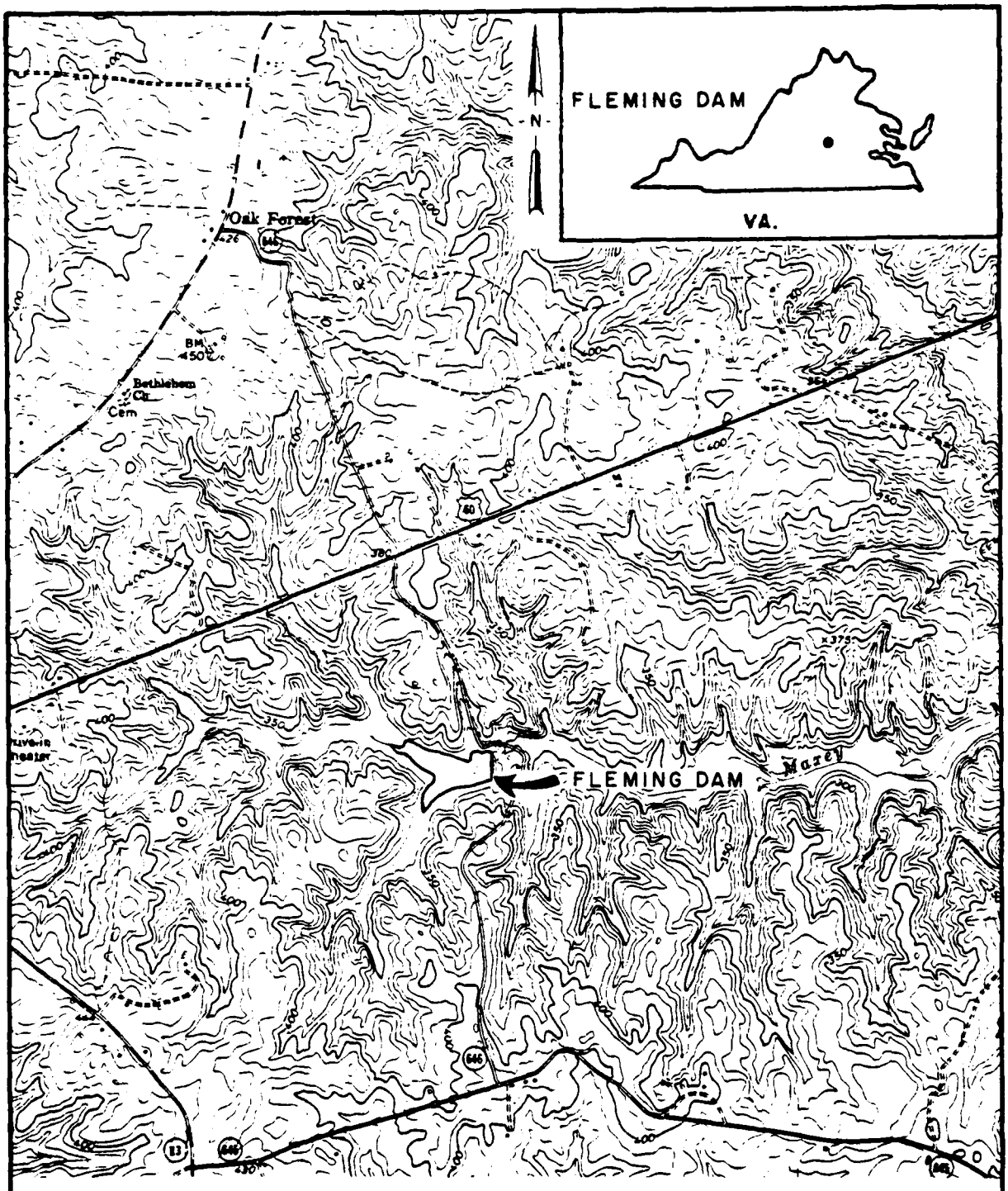
It is also recommended that consideration be given to extending the embankment through the low area to the left of the existing left abutment. Flow through this low area could result in damage to the left abutment and the downstream embankment.

APPENDIX I

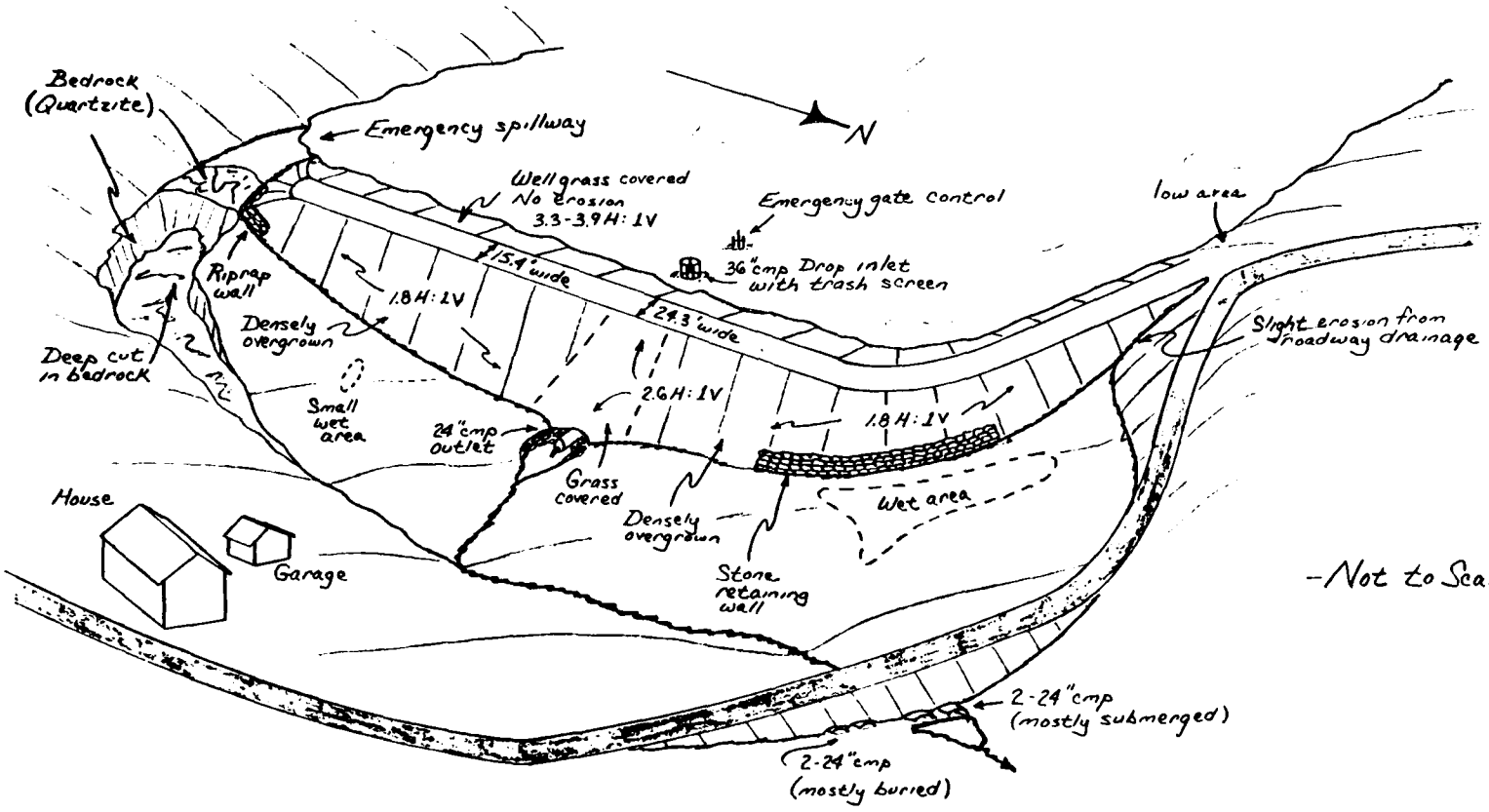
PLATES

CONTENTS

NAME OF DAM: FLEMING DAM



LOCATION PLAN



FIELD SKETCH

FLEMING DAM, VIRGINIA

Michael Baker, Jr., Inc.

11 November 1980

PLATE 1

DWH 11-80

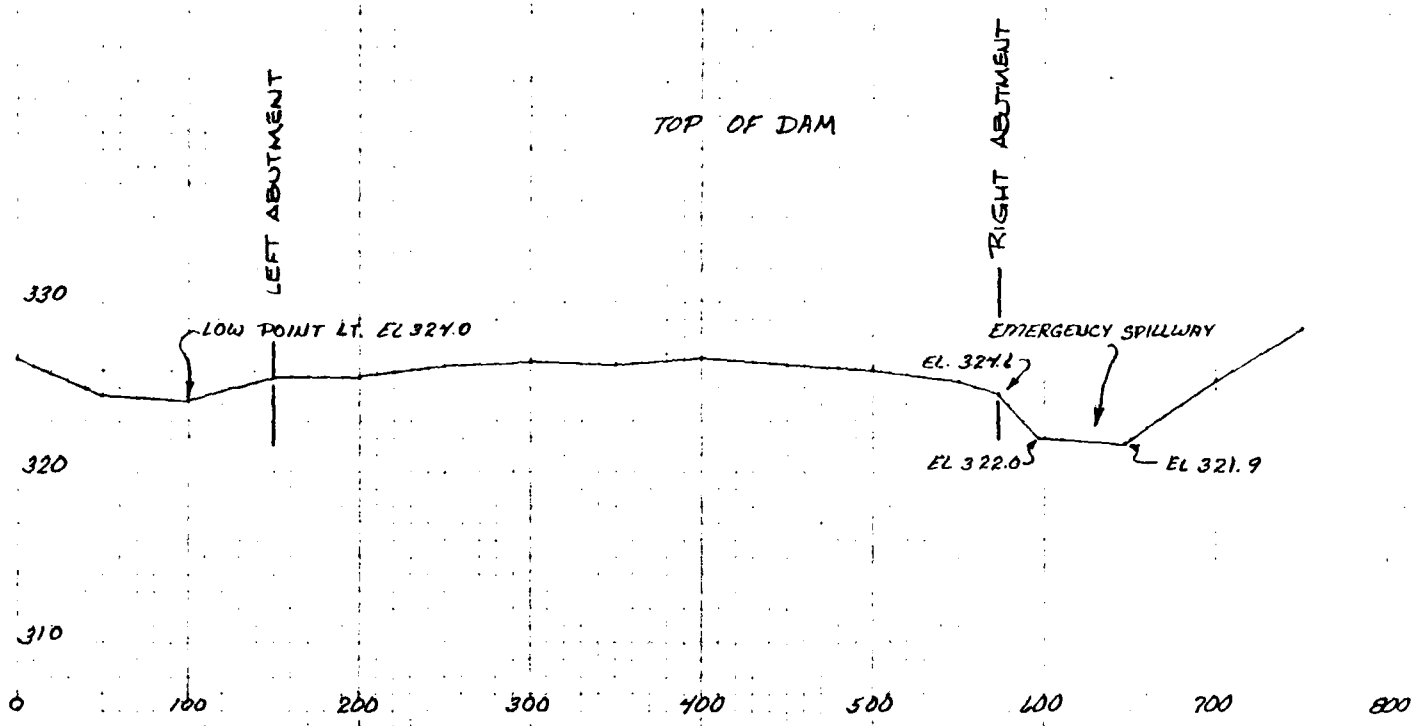
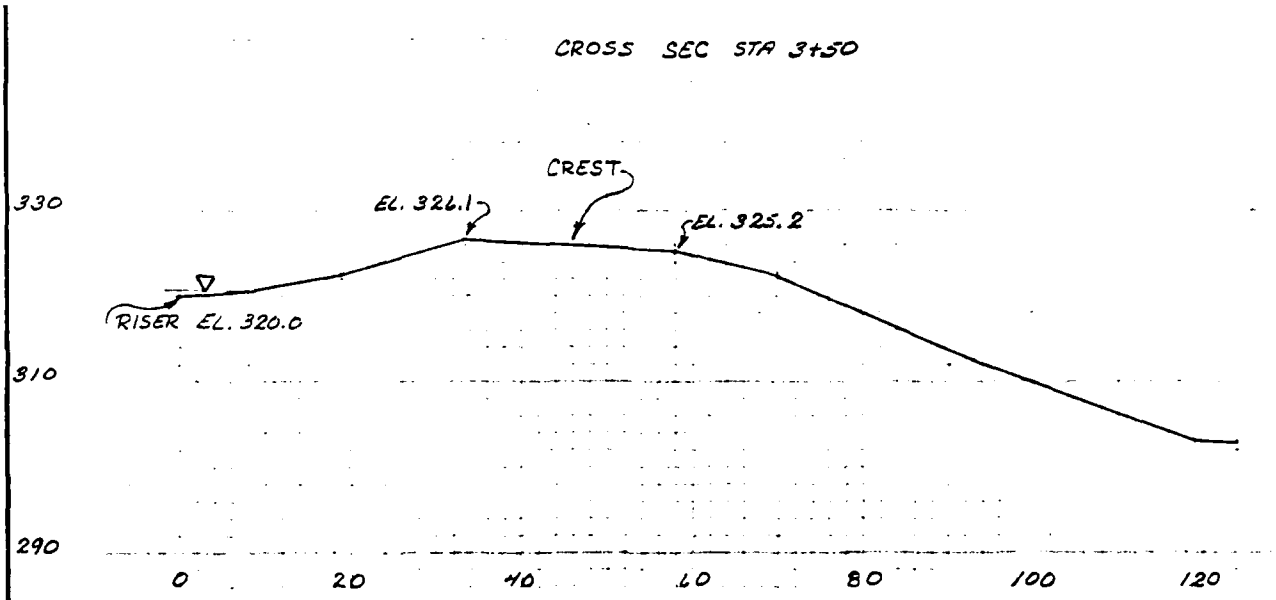

TOP OF DAM
LEFT ABUTMENT
RIGHT ABUTMENT
330
320
310
LOW POINT LT. EL 324.0
EMERGENCY SPILLWAY
EL. 324.6
EL 322.0
EL 321.9
0
100
200
300
400
500
600
700
800

PLATE 2


CROSS SEC STA 3+50
CREST
EL. 326.1
EL. 325.2
RISER EL. 320.0
330
310
290
0
20
40
60
80
100
120

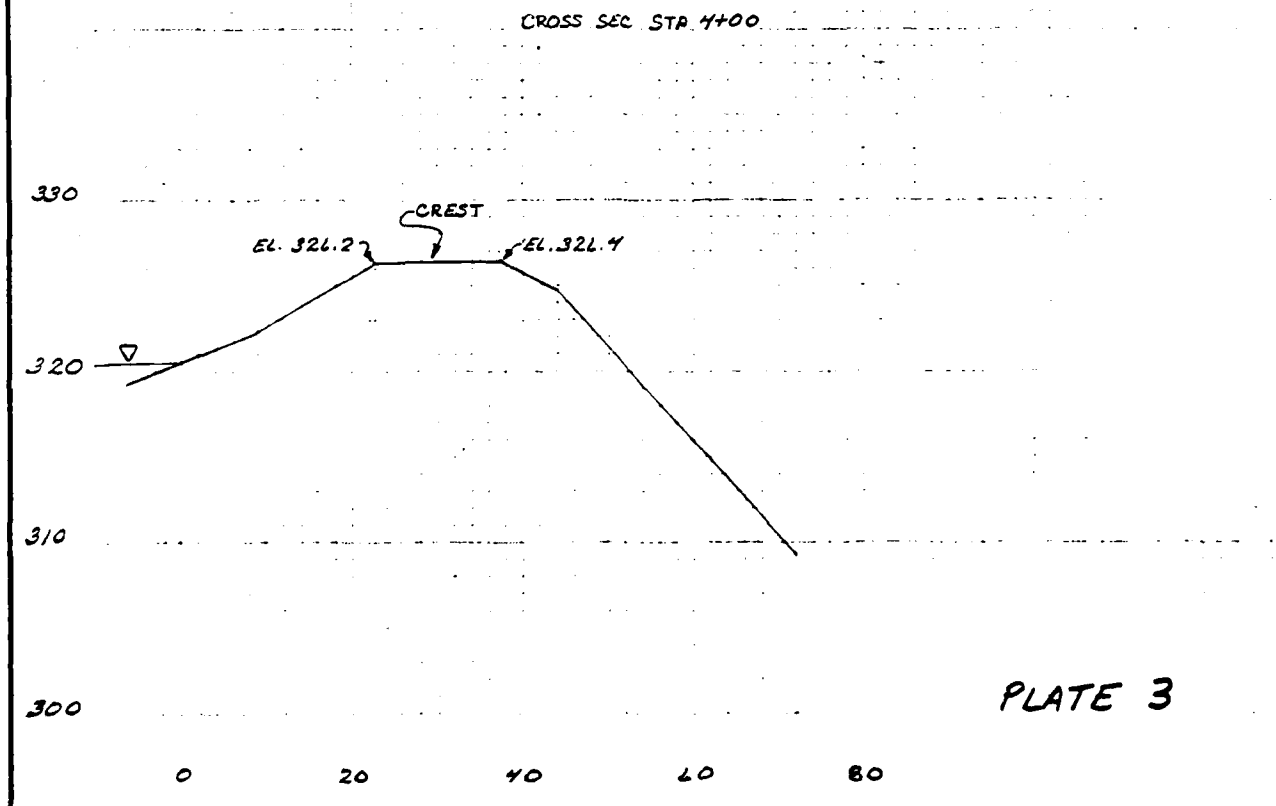

CROSS SEC STA 4+00
CREST
EL. 326.2
EL. 326.4
330
320
310
300
0
20
40
60
80

PLATE 3

APPENDIX II

PHOTOGRAPHS

CONTENTS

Note: Photographs were taken on 11 November 1980.

FLEMING DAM

PHOTO 1. Principal Spillway Inlet Trash Screen

PHOTO 2. Emergency Gate Control

FLEMING DAM

PHOTO 3. Principal Spillway Outlet

PHOTO 4. Emergency Spillway (Looking Upstream), Bedrock Control Section

PHOTO 5. Downstream Embankment, Flatter Segment Above Principal Spillway Outlet

PHOTO 6. Stone Retaining Wall Supporting Left Downstream Embankment

APPENDIX III

VISUAL INSPECTION CHECK LIST

Check List
Visual Inspection
Phase 1

Name of Dam Fleming Dam County Cumberland State Virginia **Coordinates** Lat. 3731.0
Long. 7810.8

Date of Inspection 11 November 1980 Weather Clear Temperature 45° F.

Pool Elevation at Time of Inspection 320.6 ft. T.B.M.* Tailwater at Time of Inspection 297.5 ft. T.B.M.*

*All elevations are referenced to a Temporary Bench Mark (T.B.M.) located on the top of the riser (elev. 320.0 ft.)

Inspection Personnel:

Michael Baker, Jr., Inc.:

Jeff Quay
Earl Lim
Dave Hupe

Virginia State Water Control Board:

Leon Musselwhite

Owner's Representatives:

None present

Dave Hupe Recorder

EMBANKMENT

Name of Dam FLEMING DAM

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	The upstream embankment is gently sloping and well vegetated. It shows no signs of erosion or instability. Heavy vegetation at the waterline along the upstream embankment protect the embankment against erosion from wave action. The downstream embankment is densely overgrown with brush and large trees. Numerous animal burrows were observed. Generally, the embankment appears very stable, though it is mostly quite steep and irregular. A flatter section of the embankment that is not overgrown (Continued next page)	The brush and saplings should be removed. The large trees and their root systems should be removed. The slope should then be regraded with compacted fill. The animal burrows should be backfilled. The slope should then be reseeded and mulched.

EMBANKMENT

Name of Dam FLEMING DAM

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES (Continued)	is situated directly above the outlet structure. A 6 ft. high by 75 ft. long stone wall is located along the toe of the downstream embankment approximately 125 ft. left of the principal spillway outlet structure It is in good condition.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	The horizontal alignment of the dam curves gently along its entire length, with the concave side toward the reservoir. The vertical alignment of the embankment is satisfactory. To the left of the left abutment, the natural ground and road surface form a depression approximately 125 ft. wide with a maximum depth of 1.6 ft. below the left abutment elevation.	The embankment should be extended approximately 125 ft. beyond the existing left abutment to prevent flow through the depressed area, which could result in damage to the abutment and downstream embankment. The area should be filled to the elevation of the left abutment, compacted, reseeded and mulched.
RIPRAP FAILURES	Riprap has been placed around the outlet structure and next to the embankment just downstream of the emergency spillway control section. The riprap is in good condition	

EMBANKMENT

Name of Dam FLEMING DAM

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
EMBANKMENT MATERIALS	The embankment is constructed of brown silty sand to sandy silt. Natural local soils are very sandy, due to decomposition of parent quartzite.	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	The junctions of the embankments with the abutments are generally in good condition. Slight erosion from road drainage has occurred at the junction of the downstream embankment with the left abutment.	The eroded junction of the downstream embankment with the left abutment should be filled regraded, compacted and reseeded.
ANY NOTICEABLE SEEPAGE	A few wet areas were observed beyond the downstream toe of the dam.	The wet areas are attributed to poor drainage conditions of areas below the dam, not to seepage through the embankment. As such, the wet areas do not have a detrimental effect on the dam and no corrective measures are required.
STAFF GAGE AND RECORDER	None present	A staff gage should be installed to monitor reservoir levels above normal pool.
DRAINS	No drains or signs of an internal drainage system were found.	

OUTLET WORKS

Name of Dam: FLEMING DAM

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	The outlet conduit is a 24 in. diameter bituminous coated corrugated metal pipe (C.M.P.) which is in good condition.	
INTAKE STRUCTURE	The intake structure consists of a vertical 36 in. diameter C.M.P. serving as a riser. This inlet is enclosed in a 2 ft. high cage made of reinforcing rods welded together for a trash screen. A few inches of leaves and weedy material is plugging the bottom of the trash screen.	The trash screen should be periodically cleaned to prevent possible obstruction of the principal spillway.
OUTLET STRUCTURE	The outlet structure consists of the end of the 24 in. outlet conduit protruding directly from the embankment with no visible supporting structure. The immediate outlet area is well riprapped with slate.	
OUTLET CHANNEL	The outlet channel is generally wide and unobstructed, and extends from the outlet structure approximately 50 ft. downstream, where it merges with the emergency spillway discharge channel to form the downstream channel.	

OUTLET WORKS

Name of Dam: FLEMING DAM

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
EMERGENCY GATE	The emergency gate control is located approximately 30 ft. upstream of the riser. The size of the emergency gate is unknown, and the control handle is missing.	The emergency gate control should be checked, repaired if necessary and maintained in an operable condition. The control handle should be either permantly installed or stored in an easily accessible location.

UNGATED SPILLWAY

Name of Dam: FLEMING DAM

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	The emergency spillway is adjacent to the right abutment of the embankment. The control section is not well defined, but is approximately trapezoidal-shaped with a bottom width of about 50 ft. and a depth below the right abutment of about 2.6 ft. The bottom of the channel is quartzite bedrock covered by a thin mantle of soil, less than 1 ft. deep, with grass cover. The left side slope rises to the right abutment at about a 9:1 slope, and the right side slope rises to natural ground at about a 15:1 slope. Both side slopes are composed of earth with a good grass cover.	
APPROACH CHANNEL	The approach channel is wide, well vegetated and unobstructed. A few minor erosion rills are present.	The minor erosion rills should be filled, compacted, seeded and mulched.
DISCHARGE CHANNEL	The discharge channel immediately downstream of the control section area is wide and unobstructed. The quartzite bedrock is exposed on the channel bottom just below the control section. The bedrock appears to strike N50°W and dip 10°NE and is highly jointed. A low wall of quartzite riprap has been placed on the left side of the channel just downstream of the control section to protect the right (Continued next page)	The gully in the emergency spillway discharge channel is on the side of the channel away from the embankment and poses no threat to the stability of the dam. Therefore, no remedial measures are required.

UNGATED SPILLWAY

Name of Dam: FLEMING DAM

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
DISCHARGE CHANNEL (Continued)	abutment. Approximately 100 ft. downstream of the control section, a deep gully has been cut into the quartzite on the right side of the channel. Below this point, the channel is wide, unobstructed and well vegetated with grass to its intersection with the principal spillway outlet channel, approximately 300 ft. downstream.	
BRIDGE AND PIERS	None present	

INSTRUMENTATION

Name of Dam: FLEMING DAM

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	No monumentation or permanent survey markers were found.	All elevations are referenced to a Temporary Bench Mark set on the top of the riser. The assumed elevation, and approximate Mean Sea Level elevation, of this point is 320.0 ft. T.B.M.
OBSERVATION WELLS	None present	
WEIRS	None present	
PIEZOMETERS	None present	
OTHER		

RESERVOIR

Name of Dam: FLEMING DAM

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	The slopes around the reservoir are very gentle. Half of the scopes are heavily wooded and the remainder is pastureland, used for grazing horses.	
SEDIMENTATION	The extent of sedimentation was not directly observed, but is not expected to be significant. Soundings taken during the inspection showed the greatest depth to be 14 ft.	

DOWNSTREAM CHANNEL

Name of Dam: FLEMING DAM

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	A gravel road crosses the stream approximately 300 ft. downstream. Four 24 in. diameter C.M.P.'s underlie the road. Two of these are mostly plugged with silt and abandoned. The remining two pipes are mostly submerged and would not handle much flow. Below the road, the stream flows through a fairly wide, wooded valley.	
SLOPES	The stream has a scope of approximately 0.6% in the area downstream of the dam.	
APPROXIMATE NO. OF HOMES AND POPULATION	There is one house and garage approximately 300 ft. downstream of the dam, built at approximately the same elevation as normal pool.	

APPENDIX IV

GENERAL REFERENCES

GENERAL REFERENCES

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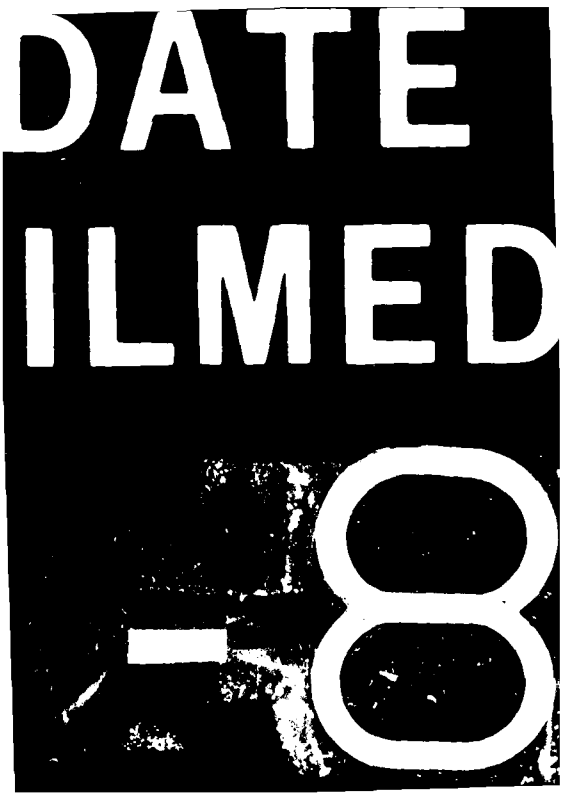
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